Physics of wind instruments an overview of studies carried out at LMA

C Vergez, W Coyle, Jean-Baptiste Doc, Ph Guillemain, A Guilloteau, J Kergomard, P Sanchez, Sarah Terrien, Lionel Velut

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an overview of studies carried out at LMA[1]

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[1] *Laboratory of Mechanics and Acoustics,* LMA, CNRS, UPR 7051, Aix-Marseille Univ, Centrale Marseille, F-13402 Marseille Cedex 20, France
Team « Sound » - 50 people working on audible sound, including musical instruments

Overall goal of our research

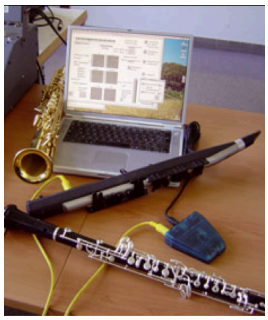
Investigate how the functionning of musical instruments depends on:
- ✓ the control parameters, adjusted by the musician during the play (e.g. blowing pressure, lips characteristics, vocal tract configuration, fingerings)
- ✓ the design parameters, fixed by the instrument maker (e.g. geometry, material)

Various approaches

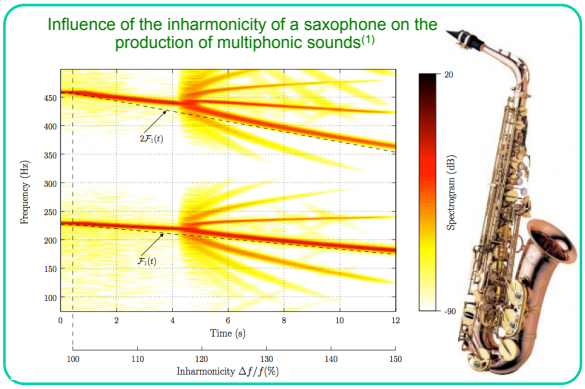
- ✓ In vivo (instrumented instrument) and in vitro measurements (artificial mouth)
- ✓ Real-time sound synthesis
- ✓ Numerical simulation and continuation
- ✓ Analytical developments

Some illustrations of recent works

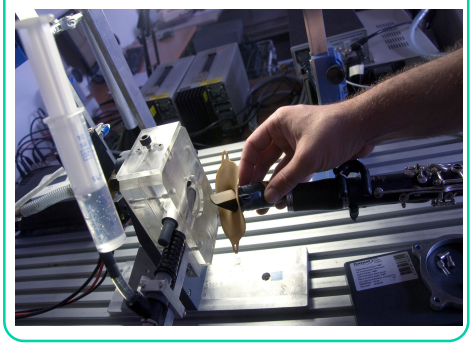
Real-time sound synthesis piloted through MIDI controllers



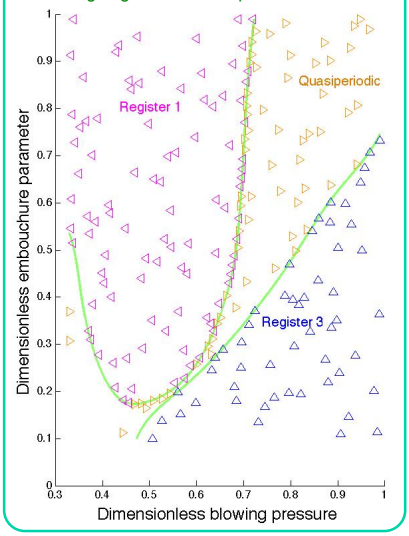
Influence of the inharmonicity of a saxophone on the production of multiphonic sounds[1]



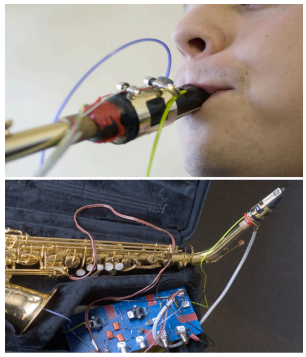
Computer controlled artificial mouth



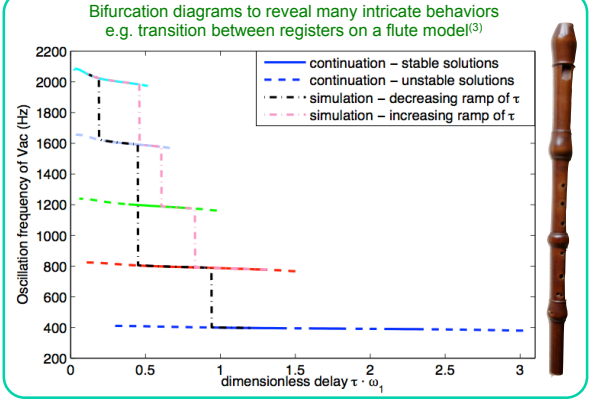
Adaptive maps of descriptors for numerical models[2]
e.g. regimes of a saxophone model

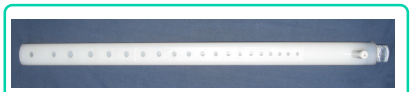


Instrumented saxophone mouthpiece to study vocal tract, lips force, …



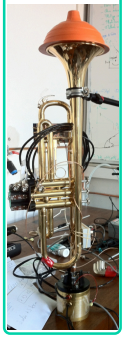
Bifurcation diagrams to reveal many intricate behaviors
e.g. transition between registers on a flute model[3]



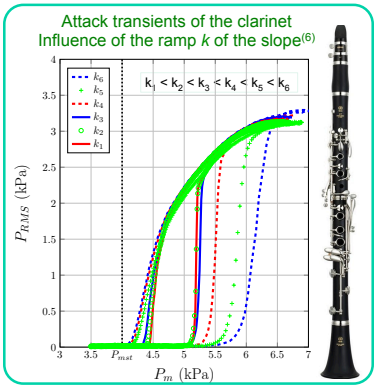


New instruments,
e.g. « logical clarinet » [4]

Instrumented trumpet[5]



Attack transients of the clarinet
Influence of the ramp *k* of the slope[6]



Collaborations

[1] Funded by Labex MEC
[2] Collaboration with Samy Missoum, University of Arizona, CODES Lab.
[3] Collaboration with Benoit Fabre, IJLRDA, Paris, and David Barton, Univ. of Bristol, England, and Ph. Bolton
[4] Collaboration with Franck Laloë, LKB, Paris and Daniel Noreland, Umea Univ., Sweden, and ANR CAGIMA (LMA, IRCAM, LSPM, Buffet Group)
[5] Funded by Labex MEC, collaboration with J.Gilbert, LAUM, Le Mans.
[6] Collaboration with André Almeida, Baptiste Bergeot, Bruno Gazengel, LAUM, Le Mans.